# DRAGONFLIES OF THE MISSISSIPPI VALLEY COLLECTED DURING THE PEARL MUSSEL INVESTIGATIONS ON THE MISSISSIPPI RIVER, JULY AND AUGUST, 1907.

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## INTRODUCTION.

Many opportunities were afforded for the collection of dragonflies in connection with the pearl mussel investigations on the Mississippi River and its tributaries during the summer of 1907. So far as practicable these opportunities were improved and a list is here presented of the different species obtained, with their geographic and seasonal distribution. Some of the territory visited had been previously worked over by dragonfly investigators in a more thorough and satisfactory manner, but much of it also was new and is here reported upon for the first time.

Then, too, all the previous work had been disconnected, confined to a single State or even a single locality, and hence there was not the same chance for correlation and comparison.

The present is the first attempt, so far as known, to collect from any considerable extent of the Mississippi River and its tributaries; and while it is confessedly deficient in many particulars, it nevertheless affords a general outlook that may be of some value. The itinerary of the trip, so far as dragonfly collecting was concerned, was as follows:

The time between July 6 and 12 was spent at St. Paul in examining some of the numerous small lakes with which that city and Minneapolis are surrounded. Leaving St. Paul on the 12th, a run was made down the Mississippi to Prescott, Wisconsin, where the party remained until the 15th. On that date the St. Croix River was ascended as far as Stillwater, Minnesota, where a stop of twenty-four hours was made, during which time dragonflies were collected from both banks of the river and from a small lake in the outskirts of the town. Returning to Prescott the next forenoon and continuing down the Mississippi, the party stopped at La Crosse, Wisconsin,

from the 20th to the 22d, and reached McGregor and Prairie du Chien on the 25th.

From Prairie du Chien on the 26th the Wisconsin and Kickapoo rivers were ascended as far as Wauzeka, where the banks of the Kickapoo and the marshy land adjacent to them were thoroughly examined for dragonflies. A return was made to McGregor the same afternoon. Again continuing down the Mississippi, the party stopped at Muscatine, Iowa, for twenty-four hours and reached Burlington in the same State on August 3. Here a stop was made until the 6th, and again both banks of the river were thoroughly examined for specimens.

From Burlington the Mississippi was descended to Grafton, Illinois, which was reached on the 11th. On the 12th the Illinois River was ascended as far as Hardin, Illinois, and a return was made on the 13th, collecting along both banks.

On the 13th also a run was made down the Mississippi to the mouth of the Missouri River, which was ascended for a few miles and back again, the party reaching St. Louis on the evening of the 13th. Leaving there the morning of the 14th, a long run was made down the Mississippi to Cairo, Illinois, at the mouth of the Ohio River, which was reached on the 19th.

During this entire run not a solitary dragonfly was seen except one or two specimens of *Libellula pulchella* Drury flying across the river.

The Ohio was then ascended on the 20th to Paducah, Kentucky, at the mouth of the Tennessee River. The next day the party started up the Tennessee and reached Riverton, Alabama, on the 24th. Here a stop was made till the 26th and considerable collecting was done. We started back down the river on the 26th for Paducah, where the trip ended on August 30.

The Mississippi River was thus covered from St. Paul to Cairo through the States of Minnesota, Wisconsin, Iowa, Missouri, and Illinois, and there were included also 40 miles of the St. Croix River, 20 miles of the Wisconsin and Kickapoo rivers, and 40 miles of the Illinois River. The Ohio River was then covered from Cairo to Paducah, between the States of Illinois and Kentucky, and the Tennessee River through the States of Kentucky and Tennessee into Alabama, making in all a distance of nearly 2,000 miles.

With the exception of a partial duplicate series, which the author was kindly allowed to retain and for which his sincere thanks are tendered to the honorable Commissioner of the Bureau of Fisheries, all the specimens collected are now in the U. S. National Museum and admit of ready reference.

A few notes descriptive of the general physical characteristics are given under such of the localities as seem to demand them. Where

they are omitted it is to be understood that the conditions were those usually found along the river—high and heavily wooded banks with a cleared area at the immediate margin of the river, more or less covered with tall grass and weeds.

## LIST OF SPECIES.

### 1. LAKE AMELIA, MINNEAPOLIS, MINNESOTA, JULY 6 AND 7.

This is a small lake west of Minneapolis which serves as one of the feeders of the Minnehaha River. It is surrounded by high and dry banks which are entirely cleared, leaving only here and there a bush or tree. The immediate shores are covered with a dense growth of grass and weeds, back of which are cultivated fields.

1. ANAX JUNIUS (Drury).
   Common around the shore and inland half a mile or so; a very strong flier and hard to capture except when mating.
2. TETRAGONEURIA SPINIGERA (Selys).
   Common flying along the shore and very close to it inland; frequently alights and can then be easily captured.
3. LIBELLULA PULCHELLA Drury.
   Common not merely around the lake but far inland over the potato and corn fields; too wary to be easily caught.
4. LIBELLULA EXUSTA Say.
   A single male captured near the shore, the dorsal surface of whose abdomen was already (July 6) deeply pruinose.
5. GOMPHUS SPICATUS Hagen.
   A single male captured in the grass along shore; no others seen, although carefully searched for.
6. LEUCORHINIA INTACTA (Hagen).
   Abundant everywhere along shore and for some distance inland.
7. CALOPTERYX MACULATA (Beauvois).
   Found in the gorge of the Minnehaha River, the outlet of Lake Amelia, below the falls; fairly common.
8. CALOPTERYX ÆQUABILIS Say.
   Found in the same gorge, but not as common as *C. maculata*.
9. LESTES INEQUALIS Walsh.
   Two specimens seen and one captured; not common.
10. LESTES UNCATUS Kirby.
    A single male captured in the grass near the shore.
11. ISCHNURA VERTICALIS (Say).
    Fairly common in the grass alongside the lake; only orange females found, no black one.
12. ENALLAGMA EBRIUM (Hagen).
    Found in company with the preceding species everywhere, even at a distance from the lake shore in the woods and cultivated fields; females as common as the males.
13. ENALLAGMA HAGENI (Walsh).
    Found everywhere, fairly swarming in the grass along shore and for some distance inland; eaten by *Gomphus spicatus*.

II. LAKE PHALEN, ST. PAUL, MINNESOTA, JULY 8.

This is a small lake northeast of St. Paul and partially outside the city limits. Its western and northern shores are covered with primeval woods, while the southern and eastern banks are low and swampy in places and clothed with dense underbrush. At the northwest corner the lake is connected with another much smaller lake or pond by a short stream which winds through an intervening strip of low marshy ground.

The banks of the smaller pond are densely wooded, except a narrow strip along the shore and around the outlet.

On the stream connecting the two bodies of water and around the shores of the smaller pond the dragonflies were especially abundant, and most of the species recorded were collected there.

The species of *Tetragoneuria* was the one most abundant on Lake Phalen itself.

1. ANAX JUNIUS (Drury).
   Fairly common around the shore; several seen closely enough for satisfactory identification, but none captured.

2. ÆSHNA JUNCEA VERTICALIS (Hagen).
   Fairly common; a female caught off the side of the trolley car just as it stopped; body very beautifully colored when alive, but fades almost immediately after death; actively feeding along the shore rather than over the water.

3. LIBELLULA PULCHELLA Drury.
   Very common; sexes about equally abundant; two females captured by hand, which had evidently recently emerged from their pupa cases.

4. LIBELLULA QUADRIMACULATA Linnæus.
   Two females secured along the shore; the only ones seen.

5. CELITHEMIS EPONINA (Drury).
   A single pair captured, which were the only ones seen.

6. GOMPHUS VILLOSIPES Selys.
   Common, squatting on the bare ground, logs, and rocks; found in company with *G. spicatus*, but is considerably larger; strong and pugnacious, catches and eats the smaller dragonflies like *Leucorhinia* and *Sympetrum*.

7. GOMPHUS SPICATUS Hagen.
   Three captured, all females; smaller than preceding but habits similar; feeds largely on damselflies, like *Enallagma* and *Ischnura*.

8. TETRAGONEURIA CYNOSURA (Say).
   Common everywhere; all secured were males; hovers over the water but rarely alights; very pugnacious, attacking and driving away *Gomphus* and even *Æshna*. No *spinigera* seen at this lake, no *cynosura* at Lake Amelia.

9. ERYTHEMIS SIMPLICICOLLIS (Say).
   Two pairs secured, both sexes in full color and not yet beginning to become pruinose.

10. LEUCORHINIA INTACTA (Hagen).
    Common everywhere, the sexes about even in numbers.

11. LEUCORHINIA PROXIMA Calvert or FRIGIDA Hagen.
Both sexes secured. Males with yellow spots along the back of the thorax and the first five abdominal segments; seventh, eighth, and ninth segments much dilated; two large yellow spots on the ventral surface of second segment; lower appendages fused with a much shallower notch between them than in *intacta*. Females with the basal half of the wings, or at least to the inclosing of the triangle, colored red; dorsal yellow spots like the male but not as distinct; ventral surface of second to seventh segments becoming pruinose.

12. SYMPETRUM RUBICUNDULUM (Say).
A single pair secured; no others seen; easily distinguished even at a distance by its brilliant red color.

13. ENALLAGMA SIGNATUM (Hagen).
Quite common flying about the floating algæ.

14. ENALLAGMA CARUNCULATUM Morse.
Fairly common, but not as plentiful as *E. ebrium* and *E. hageni*.

15. ENALLAGMA EBRIUM (Hagen).
Both sexes very common in the grass along shore.

16. ENALLAGMA HAGENI (Walsh).
Most common of all the damselflies; both sexes found everywhere in the grass and weeds along shore.

17. ENALLAGMA ANTENNATUM (Say).
Rare, only a few seen; found on rushes over the water.

18. ISCHNURA VERTICALIS (Say).
Quite common in company with *Enallagma hageni;* both sexes secured.

19. LESTES INEQUALIS Walsh.
Rare, only a single female secured.

20. LESTES VIGILAX Hagen.
A little more numerous than *L. inequalis;* mostly males.

III. BEAVER LAKE, ST. PAUL, MINNESOTA, JULY 10.

Nearly east from St. Paul, a small lake with a portion of the banks high and sandy and a portion low and swampy, everywhere covered with a dense growth of vegetation, underbrush, weeds, and grass. The two dragonflies which were most abundant were found on the high sandy banks, while the damselflies were captured in the low and wet places.

1. LIBELLULA EXUSTA Say.
Abundant everywhere, most common with *quadrimaculata* in the undergrowth close to the shore. When it alights it squats like a *Gomphus* on the rocks, stumps, and even on the ground. It is gregarious, as many as fifteen or twenty alighting on the same spot; it is also inquisitive and many were caught that actually alighted inside the net as it was being carried. The males are predominant and are all pruinose thus early, even the two antehumeral stripes showing clear white.

2. LIBELLULA QUADRIMACULATA Linnæus.
Everywhere in company with the preceding; when it alights it does not squat but perches on a twig, holding its body horizontal even if the twig is vertical. It is gregarious, like the preceding species, from

twelve to fifteen or twenty alighting on the same stalk or twig. It is not wary, but neither is it inquisitive like the preceding species. These two species of the genus were present in great numbers, the others but sparingly.

3. LIBELLULA PULCHELLA Drury.
Only a few seen and none of them secured.

4. LIBELLULA LUCTUOSA Burmeister.
Two females secured in fine color.

5. ANAX JUNIUS (Drury).
A single pair secured close to the shore.

6. TETRAGONEURIA SPINIGERA (Selys).
Common everywhere, but not in great numbers like *Libellula exusta* and *L. quadrimaculata*.

7. LEUCORHINIA INTACTA (Hagen).
Common, but in small numbers; at Curve Lake, which is badly polluted by drainage from some harvester works in the immediate vicinity, this was the only dragonfly to be seen.

8. LEUCORHINIA PROXIMA Calvert, or FRIGIDA Hagen.
This is the same species as was found at Lake Amelia; only a few specimens were seen, and these were all secured.

9. ENALLAGMA HAGENI (Walsh).
Very common; hundreds secured by a single sweep of the net through the long grass along shore.

10. ENALLAGMA EBRIUM (Hagen).
Not as common as the preceding; about in the proportion of one to ten.

11. NEHALENNIA IRENE (Hagen).
Both sexes fairly common, but not in such numbers as *Ischnura posita*.

12. ISCHNURA POSITA (Hagen).
Found in company with *Enallagma hageni* and *E. ebrium* everywhere; not as plentiful as the former, but more so than the latter.

IV. MISSISSIPPI RIVER, BETWEEN ST. PAUL AND HASTINGS, JULY 12.

1. LIBELLULA PULCHELLA Drury.
Not common; only a few seen flying across the river.

2. LIBELLULA QUADRIMACULATA Linnæus.
Common on the bluffs on the east bank of the river; both sexes secured.

3. LIBELLULA LUCTUOSA Burmeister.
Both sexes captured upon the same bluffs on which *L. quadrimaculata* was taken.

4. PLATHEMIS LYDIA (Drury).
Not common, only two specimens secured, both females.

5. GOMPHUS FRATERNUS (Say).
A couple of males were secured from the river bank just below St. Paul.

6. LEUCORHINIA INTACTA (Hagen).
Common everywhere along both banks of the river.

7. LEUCORHINIA PROXIMA Calvert or FRIGIDA Hagen.
The same species as previously recorded, obtained from the bluffs along the east side of the river.

8. TETRAGONEURIA CYNOSURA (Say).
Common everywhere, flying over the water and along the banks.

9. TETRAGONEURIA SPINIGERA (Selys).
As common as the preceding; some dead ones seen floating in the water, with fish jumping for them.

10. ARGIA APICALIS (Say).
Both sexes found around the heaps of clam shells on the east bank of the river near Pleasant Farms.

11. ARGIA MŒSTA PUTRIDA (Hagen).
Both sexes found in company with *A. apicalis.*

12. ÆSHNA JUNCEA VERTICALIS (Hagen).
Many seen flying across the river and along the east bank.

13. ANAX JUNIUS (Drury).
Many seen flying across the river and along both banks.

It was noted that the species of *Tetragoneuria* mated most often during the hour preceding sunset. Many couples could then be seen flying over the water, and they would approach the boat and even alight on it. *Gomphus*, *Anax*, and *Æshna* were each seen plunging into the water after insects. *Anax* went in like a kingfisher, submerging its whole body and evidently grasping the insect with its feet. None of them apparently wet its wings while doing this, at least not enough to hinder it at all in its flight.

V. PRESCOTT, WISCONSIN, JULY 13 TO 15.

1. LIBELLULA PULCHELLA Drury.
Not common, only a few seen flying across the river.

2. LIBELLULA QUADRIMACULATA Linnæus.
Only four individuals of this species seen.

3. ÆSHNA CONSTRICTA Say.
Common flying about in the woods near the St. Croix River; four females secured. It alights on the sides of tree trunks or hangs vertically downward from the underside of a twig or a leaf, and in this position quietly munches the insect it has secured. It is more active toward night, coming out of the woods and flying about over the water.

4. GOMPHUS VASTUS Walsh.
Common on the rocks along the shore of the river; all that were secured proved to be males.

5. GOMPHUS FRATERNUS (Say).
Not as common as *G. vastus;* the two that were secured were females.

6. DIDYMOPS TRANSVERSA (Say).
Two males caught in the woods along shore, others seen but only in a single restricted locality.

7. ARGIA MŒSTA PUTRIDA (Hagen).
Both sexes common along the rocky shore close to the water.

8. ARGIA VIOLACEA (Hagen).
Both sexes common in company with *A. mœsta putrida.*

9. LESTES RECTANGULARIS Say.
Three males taken in the grass along the banks some distance from the water, where it was shady; four other males were taken along a slough on the opposite side of the river.

10. GOMPHUS EXTERNUS Selys.
A single male taken on the river bank in front of the town.

11. LIBELLULA LUCTUOSA Burmeister.
Both sexes found at a small pond south of the town.

12. PLATHEMIS LYDIA (Drury).
Both sexes found at the same pond with *Libellula luctuosa*.

13. CALOPTERYX ÆQUABILIS Say.
A single pair seen in the slough opposite Prescott.

14. HETÆRINA AMERICANA (Fabricius).
A single specimen seen on the island opposite the town.

15. ENALLAGMA HAGENI (Walsh).
Sparsely scattered along the river's edge.

16. ENALLAGMA EBRIUM (Hagen).
A few found with *E. hageni*.

VI. STILLWATER, MINNESOTA, JULY 15.

On the St. Croix River; the banks of the river are high and dry and well wooded, except an area just opposite the town where formerly stood a large sawmill. The refuse accumulating from this mill has formed a terrace along the river's edge elevated well above the water and without a shred of vegetation anywhere upon it.

1. LIBELLULA QUADRIMACULATA Linnæus.
Found by the hundreds in the old lumber yard on the bank of the St. Croix opposite Stillwater; every stick, stub, and bush alive with them. They were very tame, alighting not merely on the net but also on the hand and arm and all over the clothing. This and the other four species here listed were the only dragonflies seen.

2. LEUCORHINIA INTACTA (Hagen).
Common, but not nearly as numerous as *Libellula quadrimaculata*.

3. ARGIA TIBIALIS (Rambur).
Both sexes flying about in the open sunshine in company with *Libellula quadrimaculata* and *Leucorhinia intacta*.

4. ARGIA APICALIS (Say).
A few males found in company with *A. tibialis*.

5. PLATHEMIS LYDIA (Drury).
Both sexes found on the river bank a little below the lumber yard.

VII. LILY LAKE, STILLWATER, MINNESOTA, JULY 16.

A small sheet of water on the high ground to the west of the town; its western and northern banks are covered by dense underbrush, the eastern and southern banks cleared and occupied by dwellings. From the southeast corner proceeds a small outlet, winding about through soft, marshy land. The dragonflies were most abundant along this outlet and on the margin of the lake in its immediate vicinity.

1. EPICORDULIA PRINCEPS (Hagen).
A few seen patrolling the shore; one male captured.

2. LIBELLULA LUCTUOSA Burmeister.
Both sexes quite plentiful in one restricted area at the northwest corner of the lake.

3. LIBELLULA PULCHELLA Drury.
Common, many of the females just out of their pupa cases.

4. ERYTHEMIS SIMPLICICOLLIS (Say).
Common everywhere.

5. PLATHEMIS LYDIA (Drury).
Fairly common, many of the females just emerged from their pupa cases.

6. LEUCORHINIA INTACTA (Hagen).
Common everywhere; the most numerous species seen.

7. TETRAGONEURIA SPINIGERA (Selys).
A single female taken and one or two others seen.

8. DOROCORDULIA LIBERA (Selys).
Several seen flying about over the small stream which serves as the outlet to the lake; distinguished readily by its inflated abdomen; hard to catch, but both sexes secured.

9. LIBELLULA QUADRIMACULATA Linnæus.
Found in company with *Dorocordulia libera* and quite common; but it is very wary here, and it was extremely difficult to secure even a single specimen.

VIII. RED WING, MINNESOTA, JULY 17.

1. LIBELLULA PULCHELLA Drury.
Several seen flying across the river.

2. ANAX JUNIUS (Drury).
Many seen patrolling the river banks.

3. PLATHEMIS LYDIA (Drury).
Both sexes seen along the river bank just above town.

4. GOMPHUS EXTERNUS Selys.
A single pair captured on the river bank.

5. GOMPHUS VASTUS Walsh.
Common everywhere; most of the specimens secured were males.

6. GOMPHUS CRASSUS Hagen.
A single female secured in company with *G. vastus*.

7. GOMPHUS FRATERNUS (Say).
Both sexes fairly common.

8. GOMPHUS AMNICOLA Walsh.
A single female secured in company with *G. fraternus*.

9. LESTES INEQUALIS Walsh.
Both sexes common in shady places near the woods.

10. ARGIA TIBIALIS (Rambur).
Both sexes common along the river bank.

11. ARGIA APICALIS (Say).
Found in company with *A. tibialis*, but not as plentiful.

12. ARGIA MŒSTA PUTRIDA (Hagen).
A few individuals found along the river bank.

13. ENALLAGMA HAGENI (Walsh).
Found in the grass along the river bank.

14. ENALLAGMA EBRIUM (Hagen).
Found in company with *E. hageni*.

IX. WINONA, MINNESOTA, JULY 19.

1. LIBELLULA PULCHELLA Drury.
Several seen flying across the river.

2. PLATHEMIS LYDIA (Drury).
Both sexes taken along the river bank.

3. ARGIA MŒSTA PUTRIDA (Hagen).
A few in the open spaces close to the water's edge.

4. ISCHNURA POSITA (Hagen).
A few taken in company with *E. hageni* and *E. ebrium*.

5. ENALLAGMA HAGENI (Walsh).
Fairly common in the tall grass along the river banks.

6. ENALLAGMA EBRIUM (Hagen).
Found with *E. hageni*, but not so numerous.

X. HOMER, MINNESOTA, JULY 20.

Very few dragonflies or damselflies seen; a few individuals of *Libellula pulchella* Drury, *Anax junius* (Drury), and *Plathemis lydia* (Drury) observed flying across the river. *Lestes vigilax* Hagen, *L. rectangularis* Say, and *Argia moesta putrida* (Hagen) taken in small numbers along the river banks.

XI. REEDS LANDING, MINNESOTA, JULY 18.

1. ANAX JUNIUS (Drury).
Common patrolling the shore or flying over the water.

2. GOMPHUS FRATERNUS (Say).
Both sexes captured along the sandy shores.

3. GOMPHUS VASTUS Walsh.
More specimens, including both sexes, of this species were here secured than at any other locality on the river; the banks of the river with alternating reaches of sand and gravel seemed peculiarly attractive to these dragonflies.

4. SYMPETRUM ALBIFRONS (Charpentier).
Both sexes were captured in the tall weeds along the edge of the woods; they seem to prefer shady spots.

5. SYMPETRUM RUBICUNDULUM (Say).
A single male was found in company with *S. albifrons*.

6. CALOPTERYX MACULATA (Beauvois).
Both sexes common along the steep banks where the grass reaches to the water's edge and there is a swift current.

7. CALOPTERYX ÆQUABILIS Say.
Both sexes of this damselfly were found in company with *C. maculata*, but were not so numerous.

8. LESTES VIGILAX Hagen.
Both sexes found in the tall weeds and grass back from the water; not very common.

9. LESTES RECTANGULARIS Say.
Both sexes secured in company with *L. vigilax*.

10. ARGIA MŒSTA PUTRIDA (Hagen).
A few specimens seen along the river banks.

XII. LA CROSSE, WISCONSIN, JULY 20 TO 22.

Just to the north of the city the banks of the Mississippi are low and swampy and traversed by numerous streams and bayous. The

railroad tracks cross and recross this region in many directions and afford a convenient means of reaching localities that would otherwise be inaccessible. Much of the collecting was done along these railroad tracks.

1. LIBELLULA PULCHELLA Drury.
   Common everywhere around the outskirts of the town.

2. PLATHEMIS LYDIA (Drury).
   A single colony, including both sexes, of this species was discovered at a small pond just north of the railroad tracks; none was seen anywhere else.

3. ANAX JUNIUS (Drury).
   Very common over the marshes and along the La Crosse River above the city.

4. EPICORDULIA PRINCEPS (Hagen).
   A few seen patrolling the banks of the La Crosse River.

5. SYMPETRUM RUBICUNDULUM (Say).
   A few individuals secured in the edge of the woods back of the railroad tracks.

6. GOMPHUS FRATERNUS (Say).
   Both sexes captured on the gravel along the river bank.

7. GOMPHUS VASTUS Walsh.
   In company with *G. fraternus* and more numerous.

8. PERITHEMIS DOMITIA (Drury).
   Both sexes obtained at the lake in the park.

9. ENALLAGMA HAGENI (Walsh), E. EBRIUM (Hagen), and E. SIGNATUM (Hagen).
   Found together in the long grass and weeds along the river bank; the first-named species the most abundant.

10. LESTES RECTANGULARIS Say and L. VIGILAX Hagen.
    Found a little distance back from the water, near the woods.

11. ARGIA MŒSTA PUTRIDA (Hagen) and A. APICALIS (Say).
    Found in the shrubbery along the water's edge, the last mentioned the most abundant species.

12. ISCHNURA VERTICALIS (Say).
    A few found in company with the species of *Enallagma*.

XIII. BROWNSVILLE, WISCONSIN, JULY 23.

After leaving La Crosse the only Neuroptera seen were at Brownsville, Wisconsin, Crosby's Slough, Minnesota, and Victory, Wisconsin. At each of these places the high and wooded banks yielded three species of *Argia*, namely *mœsta putrida* (Hagen), *tibialis* (Rambur), and *apicalis* (Say), their relative abundance being in the order named.

Where the shores became sandy and less steep two species of *Gomphus*, *vastus* Walsh and *fraternus* (Say) were predominant, flying over the water and patrolling the banks. Apparently these two genera did not intermingle to any extent, but each was colonized by itself.

XIV. LANSING, IOWA, JULY 24.

Only two species of *Gomphus*, *vastus* Walsh, and *externus* Selys, were seen at this station or along the river above and below it.

XV. PRAIRIE DU CHIEN, WISCONSIN, JULY 25.

Again only two species of dragonflies seen, *Gomphus externus* Selys, and *Plathemis lydia* (Drury); both of these were fairly common. The river banks were low, flat, and sandy, and in the scattered weeds were obtained *Argia tibialis* (Rambur), *A. apicalis* (Say), and *Ischnura verticalis* (Say), none of the three at all common.

XVI. HORSESHOE LAKE, OPPOSITE McGREGOR, IOWA, JULY 26.

Another excellent example of colonization, *Perithemis domitia* (Drury), was found here by the hundreds, the males out on the lily pads in the open lake, the females in the weeds along the shore. This species was seen at only a few other places, and then only sparingly. *Epicordulia princeps* (Hagen), and *Libellula pulchella* Drury were the only other dragonflies seen; the former were much the more numerous and were patrolling the pickerel weed and rushes along the shore. The lily pads and rushes were further tenanted by three species of *Enallagma*, *hageni* (Walsh), *ebrium* (Hagen), and *signatum* (Hagen), none of them at all numerous. In addition there were a few specimens of *Ischnura verticalis* (Say).

XVII. WAUZEKA, WISCONSIN, JULY 26.

This was 15 miles up the Wisconsin River and a half mile up the Kickapoo River, on the banks of the latter. The ground was all marsh land, soggy and wet, with standing water everywhere. Here was found a colony of *Plathemis lydia* (Drury), both sexes of which were present in large numbers, flying about over the water. The only other dragonflies seen were *Gomphus externus* Selys, a pair of which were captured in one of the dry spots on the marshes, while others were seen flying over the water and along the flat, dry banks of the Wisconsin River. There were also a few males of *Perithemis domitia* (Drury) seen on the marshes, and *Libellula pulchella* Drury flying over the fields farther back from the water. Of the damselflies, *Hetærina americana* (Fabricius) was found along the grassy banks of the Wisconsin River in limited numbers, while *Lestes rigilax* Hagen was found in the rushes on the marshes.

XVIII. GUTTENBURG, IOWA, JULY 27.

Here was a flat, dry shore, raised considerably above the water and covered thickly with weeds. On it were found *Libellula luctuosa* Burmeister and *Gomphus externus* Selys, while flying about over the water were *Epicordulia princeps* (Hagen) and a few males of *Perithemis domitia* (Drury). Of damselflies there were found *Enallagma hageni* (Walsh), *Ischnura verticalis* (Say), and *Lestes rectangularis* Say.

XIX. CLINTON, IOWA, JULY 30 AND 31.

From Guttenburg to Clinton the shore was dry and sandy and yielded nothing but *Argia tibialis* (Rambur) and *Argia apicalis* (Say), and the two species of *Gomphus*, *vastus* Walsh and *externus* Selys.

At Send Prairie, Illinois, the sand was raised in high bluffs along the shore, and here the two species of *Gomphus* were specially abundant. Elsewhere even the species of *Argia* were scarce and no other kinds were seen. At several of the landings just above Clinton not even a single specimen of dragonflies or damselflies could be found by careful and long-continued hunting. Taken all in all, this was the most barren section of the river encountered during the entire season, except that between St. Louis and Cairo.

XX. LE CLAIRE, IOWA, JULY 30.

The shores at this place were high, dry, and sandy, and there were very few dragonflies or damselflies to be seen. *Epicordulia princeps* (Hagen), *Tetragoneuria cynosura* (Say), *Perithemis domitia* (Drury), and *Argia tibialis* (Rambur) comprised all that could be found, and of the first three only a single specimen was seen.

XXI. MUSCATINE, IOWA, AUGUST 1.

Here the shore was low and covered with a rich growth of weeds, in which there was the greatest variety of dragonflies and damselflies, in the smallest space, of any locailty on the river.

Only a few moments could be spent in collecting, but in that time 14 species were secured.

1. ÆSHNA JUNCEA VERTICALIS (Hagen).
   Two specimens taken in the high bushes back from the shore.
2. EPICORDULIA PRINCEPS (Hagen).
   A single specimen seen patrolling the river bank.
3. LIBELLULA PULCHELLA Drury.
   Common everywhere along the banks and over the water.
4. LIBELLULA LUCTUOSA Burmeister.
   A few males found in the weeds along shore.
5. GOMPHUS AMNICOLA Walsh.
   A single pair captured on the rocks at the water's edge.
6. ERYTHEMIS SIMPLICICOLLIS (Say).
   Males common on the river bank, but only a few females seen.
7. PACHYDIPLAX LONGIPENNIS (Burmeister).
   A single specimen taken in the thick undergrowth.
8. PERITHEMIS DOMITIA (Drury).
   A single female captured at the water's edge; no others seen.
9. SYMPETRUM VICINUM (Hagen).
   Fairly common along the edge of the woods back from the river bank.
10. ARGIA MŒSTA PUTRIDA (Hagen).
    Common everywhere in the dry and open places on the banks.

11. ARGIA TIBIALIS (Rambur).
Found in company with *A. mœsta putrida*, and about as common.

12. LESTES VIGILAX Hagen.
A single specimen taken in the thick weeds.

13. ISCHNURA VERTICALIS Say.
Also rare; a few specimens secured in a patch of long grass.

14. ENALLAGMA GEMINATUM Kellicott.
Rare; a few found in company with *I. verticalis*.

At a landing a couple of miles above the town on the river bank an hour's search revealed nothing but *Argia mœsta putrida*, and seemingly the locality was fully as favorable as this other one.

XXII. BURLINGTON, IOWA, AUGUST 3 TO 6.

1. ANAX JUNIUS (Drury).
Several seen and one found mutilated on the shore.

2. ÆSHNA CLEPSYDRA Say.
A single male captured in the woods near the river.

3. TETRAGONEURIA CYNOSURA (Say).
Several seen along the water's edge.

4. LIBELLULA PULCHELLA Drury.
Common everywhere, particularly along the western bank of the river.

5. PLATHEMIS LYDIA (Drury).
Rare; only a few males seen.

6. GOMPHUS DESCRIPTUS Banks.
A couple of females secured on the rocks near the river.

7. ERYTHEMIS SIMPLICICOLLIS (Say).
Common on both banks near the water.

8. PERITHEMIS DOMITIA (Drury).
A single pair taken on the west bank.

9. PACHYDIPLAX LONGIPENNIS (Burmeister).
More common on the eastern bank of the river.

10. SYMPETRUM RUBICUNDULUM (Say).
Found in company with *Pachydiplax longipennis* on the eastern bank of the river.

11. ISCHNURA VERTICALIS (Say).
Common everywhere in the grass along the water's edge.

12. ARGIA TIBIALIS (Rambur).
Found in the more open places and very common.

13. ARGIA APICALIS (Say).
Found with *A. tibialis* and nearly as common.

14. ARGIA MŒSTA PUTRIDA (Hagen).
Common on the western bank, but none could be found on the eastern side; prefers the rocks and sand along the water's edge.

15. ENALLAGMA ANTENNATUM (Say).
A single male secured in company with *Ischnura*.

16. HETÆRINA AMERICANUA (Fabricius).
A single male was secured from O'Connell slough which had escaped from its pupa case so recently that its color was not yet defined.

There was no evidence of colonization here, but a fairly even distribution of all the species. Several individuals of *Libellula pul-*

*chella* Drury were observed going to roost for the night in the tall ironweed along a dried-up overflow bottom. When roosting they flatten back against the vertical stem of the weed instead of holding their bodies horizontal as is done when they alight in the daytime, possibly as a protection against rain. This was not the right kind of a shore for *Gomphus*, and hence only the single pair was seen.

XXIII. QUINCY, ILLINOIS, AUGUST 9.

Only a half-hour could be spent here, and in that time the following species were either seen or secured: *Libellula pulchella* Drury, *Æshna juncea verticalis* (Hagen), *Pachydiplax longipennis* (Burmeister), *Gomphus amnicola* Walsh, *Argia tibialis* (Rambur), and *A. mœsta putrida* (Hagen).

XXIV. HANNIBAL, MISSOURI, AUGUST 10.

Two hours in the afternoon and the same period the next forenoon were spent here in collecting, but with limited results. There were hundreds of *Libellula pulchella* Drury flying across the river and over the inland fields, but the only other species found were *Gomphus externus* Selys, *G. amnicola* Walsh, *Pachydiplax longipennis* (Burmeister). *Argia mœsta putrida* (Hagen), *A. tibialis* (Rambur), and *A. apicalis* (Say), and of these there was only a single specimen of each of the first three.

XXV. THE ILLINOIS RIVER, AUGUST 12.

In passing up the river from Grafton to Hardin two distinct colonies of *Erythemis simplicicollis* (Say) were found. The first was 10 miles above Grafton, where the east bank of the river was covered with hundreds of this species, including both sexes, while many were flying across the river.

The other colony was 4 miles farther up the river, at the head of an island. Here the island seemed to be the headquarters from which the dragonflies flew out in every direction.

Just below Coon Creek an abundance of *Libellula pulchella* Drury was observed, and they could be seen flying over the inland fields. Repeated observations seemed to indicate that in general the flight was from the shady to the sunny side of the river, from east to west in the forenoon and from west to east in the afternoon.

XXVI. COON CREEK, ILLINOIS, AUGUST 12.

This was between the colony of *Libellula* and one of *Erythemis*, and there were found here, naturally, these two species, though in limited numbers, and beside them *Pachydiplax longipennis* (Burmeister), fully as numerous as either of the preceding, *Celithemis eponina* (Drury), *Tetragoneuria cynosura* (Say), and *Gomphus plagiatus* Selys.

Of damselflies there were the two species of *Argia*, *apicalis* (Say) and *tibialis* (Rambur).

XXVII. HARDIN, ILLINOIS, AUGUST 12 AND 13.

Here were found a few specimens each of *Libellula pulchella* Drury, *Tetragoneuria cynosura* (Say), *Anax junius* (Drury), and *Gomphus amnicola* Walsh, together with large numbers of *Ischnura verticalis* (Say), and a few males of *Enallagma piscinarium* Williamson.

XXVIII. MISSISSIPPI RIVER FROM GRAFTON TO CAIRO, ILLINOIS, AUGUST 13 TO 20.

No stops were made between Grafton and the mouth of the Missouri River, but the dragonflies and damselflies were as common as they had been and could be seen along either bank flying over the water or in the bushes. A run was made up the Missouri for 8 or 10 miles and back, but not a solitary dragonfly was seen, and this continued all the way down to Cairo.

Repeated landings were made and the banks diligently searched for specimens, but without finding even one. This abrupt demarkation is no doubt due to the muddy water poured in by the Missouri River. No dragonfly larva could rightly be expected to live in such a medium, and their absolute refusal is what might naturally be looked for.

XXIX. JOHNSONVILLE, TENNESSEE, AUGUST 21.

On ascending the Ohio River the dragonflies began to appear again, and were as numerous as ever on reaching Paducah, at the mouth of the Tennessee River. For the entire length of this latter river to Riverton, Alabama, *Gomphus* was particularly abundant and could be seen at all hours of the day flying over the water. The first stop for collecting was made at Johnsonville, and here were found *Libellula pulchella* Drury, *Macromia tæniolata* Rambur, *Erythemis simplicicollis* (Say), *Pachydiplax longipennis* (Burmeister), *Plathemis lydia* (Drury), *Argia mœsta putrida* (Hagen), *A. tibialis* (Rambur), *A. violacea* (Hagen).

The shore at this particular place was not suitable for *Gomphus*, and none was secured.

XXX. SAVANNAH, TENNESSEE, AUGUST 23.

Here the shores were favorable for *Gomphus* and three species were caught—*vastus* Walsh, *notatus* Rambur, and one undetermined. No other dragon flies seen.

XXXI. RIVERTON, ALABAMA, AUGUST 24 TO 26.

The banks of the river were high and dry, except in one place in the outskirts of the town, where were a few small swampy ponds.

Here were found large numbers of *Libellula pulchella* Drury with *Plathemis lydia* (Drury) and a species of *Macromia*.

Along the river bank *pulchella* was not as numerous, and there were associated with it *Erythemis simplicicollis* (Say), *Pachydiplax longipennis* (Burmeister), *Macromia taeniolata* Rambur, *Gomphus vastus* Walsh, *G. notatus* Rambur, two species of *Hetærina*, one of which was *americana* (Fabricius), *Argia tibialis* (Rambur), *Argia violacea* (Hagen), and a species of *Anax*, of which none could be obtained.

## SUMMARY.

Certain facts must be kept in mind while endeavoring to summarize these observations.

1. With few exceptions the examination of each locality was confined to a period of only a few hours duration. Hence the species obtained would represent the fauna of the locality for that day only, and would give but few suggestions in reference to its fauna at other times, or to seasonal changes.

2. The dates for each of the localities examined were different. While this would have little practical influence for neighboring localities visited within a few days of each other, it would mean a great deal when the interval was increased to a month, or even two months.

3. There was a continual progress in the localities visited from Minnesota, one of the extreme Northern States, to Alabama, one of the extreme Southern. Hence the geographic changes would cause considerable differences in the fauna, irrespective of the seasonal changes, and by thus combining the two their separate influence would be much augmented.

In spite of these difficulties, however, there are certain conclusions which may be fairly drawn from the observations which have just been recorded.

1. A small fresh-water lake or pond, surrounded by shrubbery and vegetation, furnishes the ideal breeding place for dragonflies and damselflies, with which even such a river as the Mississippi, with its numerous sloughs and bayous, is scarcely worthy of comparison. The larvæ of these insects evidently prefer clean to muddy water as a medium in which to live; in witness whereof may be cited the fact that not a solitary specimen of the Neuroptera was seen on the Missouri River or on the Mississippi between the mouth of the Missouri and the mouth of the Ohio.

2. Only a single species was found in all the localities visited. This species, *Libellula pulchella* Drury, may therefore be taken as the most widely distributed in the Mississippi Valley, both geographically and seasonally. A close second was furnished by *Pachydiplax longipennis* (Burmeister), which appeared in nearly all the localities. Furthermore, neither of these species was found colonized anywhere.

3. The genus *Gomphus* is chiefly the guardian of the river. The species may be seen at all times of day patrolling the river's surface with tireless vigilance or squatting upon the shore and watching their surroundings intently, and woe betide the luckless insect that comes within their reach. All of the species observed are remarkably alike in their habits so that it is practically impossible to distinguish them until after they are caught. This genus also was found universally distributed and not colonized.

4. The other dragonflies and the damsels, on the contrary, were found in colonies, each made up of a few closely related species that harmonize well with one another and restricted in its area with fairly well-defined borders. A few of these colonies are worthy of special mention.

A. The first was at Beaver Lake in St. Paul and was made up of *Libellula exusta* Say and *L. quadrimaculata* Linnæus for the dragonflies, and *Enallagma hageni* Walsh for the damsels. The lake is small and surrounded by a scattering growth of underbrush and rank grass. There were hundreds of the dragonflies among the bushes and shrubs, while the tufts of grass were so loaded with *Enallagma* that a single sweep of the net secured over two hundred. While other species were found, as given in the list, it was only after long and careful search and in such small numbers as to count for nothing beside the myriads of the three species mentioned.

B. Another colony was found on the bank of the St. Croix River, opposite Stillwater, Minnesota. Here had been formerly a large sawmill, and the river bank for a long distance was packed with sawdust, bark, and edgings to the depth of several feet. Flying about over this area and alighting on the projecting sticks were swarms of *Libellula quadrimaculata* Linnæus, sometimes a dozen or more on the same stick, and with them were numerous specimens of *Argia tibialis* (Rambur), particularly along some piles of old slabs back from the water. The most careful search revealed only three other species, and in such small numbers that they could only be regarded as stragglers.

C. A third colony was found in Horseshoe Lake, a part of the river surrounded on three sides by islands and opposite the town of McGregor, Iowa. This was a colony of *Perithemis domitia* (Drury), and *Epicordulia princeps* (Hagen), the former flying over the lily pads by the score, the latter patrolling the pickerel weeds and rushes along the shore. The only other dragonfly seen after long and careful search was *Libellula pulchella* Drury, which had evidently come across from the mainland.

D. Special mention should also be made of the two colonies of *Erythemis simplicicollis* (Say) observed on the Illinois River, one

10 miles above Grafton and the other 4 miles farther up the river. These have already been referred to on page 667.

This isolation of species into colonies prevailed throughout the entire length of the various rivers visited and in some of the small lakes. It is a very different condition from what is found in other lakes where fifteen or twenty species, or even more, can be secured in a single afternoon; witness Lake Amelia and Lake Phalen. It leads naturally to the next conclusion—

5. With the exception of such genera as *Gomphus* and *Anax* and such species as *Libellula pulchella* Drury, the individual range of any dragonfly or damselfly is in all probability very small.

The members of one of these colonies just noted are probably natives of the locality. They were born there, they spend their lives in hunting the insects that surround the water, they lay their eggs in the same water, and then die. Continued observation of such a colonized area for many years would doubtless reveal much that would be of interest in its bearing upon colonization in general, as well as upon the distribution of species.